LIQUID RESISTIVE TOUCH PANEL

RELATED APPLICATIONS

[0001] This application claims priority under 35 U.S.C. § 119 based on U.S. Provisional Application Ser. No. 60/868,979, filed Dec. 7, 2006, the disclosure of which is incorporated herein by reference.

BACKGROUND

[0002] The present invention generally relates to electronic devices and, more particularly, to a resistive touch panel, as well as an information presentation device and a portable electronic device including the resistive touch panel.

[0003] In electronic devices such as portable communication devices, such as cellular phones, resistive touch panels are widely used as an input mechanism for receiving information from a user. Touch panels are often provided in conjunction with a display, such as an LCD (liquid crystal display). In such arrangements, the display may be used to render information associated with the information that is entered via the touch panel.

[0004] A resistive touch panel is often multi-layered, and may include an outer electrically conducting layer that is typically flexible, and an inner, electrically conducting layer, which are, in a normal (i.e., non-input) state, separated by an air gap. As a user contacts the touch panel (e.g., with a finger, stylus, etc.), the flexible layer is displaced toward the inner layer and the touch may thereby be (electrically) registered; after which, the flexible layer operatively returns to its original position, i.e., at a distance from the inner layer. The separation of the two electrically conducting layers is maintained, for example, using spacers disposed in the air gap.

[0005] Touch panels of the type described above are associated with a number of undesirable limitations. As the panel is often to be used in daylight or artificial light, incident light gets reflected from the different layers. The reflected light may create glare or otherwise impact visual acuity from the perspective of the user of the panel. The reflected light may also render the panel a grayish color, thereby limiting the possibility to provide differentiated designs and/or colors of images presented via the panel.

[0006] Another limitation of such touch panels is that the flexible layer, after having been pressed towards the inner layer, may not completely return to its original position. That is, an "indentation" may occur in the structure. The indentation may produce so-called, Newton's rings, or similar optical distortions, which are undesirable from the perspective of the user of the panel.

[0007] Techniques exist for removing Newton's rings. For example, a translucent or diffusive layer may be provided on the side of the inner layer facing the flexible layer, i.e., in the gap between the flexible layer and the inner layer. The diffusive layer diffuses light from the inner layer, resulting in the removal of Newton's rings. However, the diffusive layer may also diffuse light emanating from a display provided below the touch panel, thereby reducing the sharpness of an image provided by the display. An image to be presented, for example, in a relatively small portable electronic device may be reduced to an unacceptable degree of sharpness when subjected to the diffusive layer. Limited resolution due to small dimensions of the touch panel in such devices places a premium on images being as sharp as possible. This is not possible to do with the above mentioned diffusive layer.

[0008] Proposed attempts to resolve some of the unintended optical affects associated with the diffusive layer include replacing the air in the gap with particular materials. In U.S. patent application Publication No. 2003/0020540, for instance, a composite consisting of electrically conducting particles is placed between the two conducting layers. In this arrangement, the electrically conducting particles start to conduct when the flexible layer is depressed. However, the proposed composite will not, in all likelihood, improve the visibility of an underlying display due to the inclusion of the electrically conducting particles. A similar technique is described in Japanese Patent Application No. JP05-0143219.

SUMMARY OF THE INVENTION

[0009] Implementations of the present invention provide a resistive touch panel with superior optical properties.

[0010] According to a first aspect of the present invention, a resistive touch panel includes a first flexible electrically conducting layer, a second electrically conducting layer, and a separating chamber provided between the first and second electrically conducting layers, wherein the chamber includes a transparent liquid.

[0011] A second aspect of the present invention is directed to a resistive touch panel including the features of the first aspect, wherein the liquid is electrically isolating.

[0012] A third aspect of the present invention is directed to a resistive touch panel including the features of the third aspect, wherein the liquid is a chemically non-reactive liquid at least regarding the materials that make up the walls of the chamber.

[0013] A fourth aspect of the present invention is directed to a resistive touch panel including the features of the first aspect, wherein the liquid is insensitive to temperature and pressure.

[0014] A fifth aspect of the present invention is directed to a resistive touch panel including the features of the first aspect, wherein the liquid has a refractive index that is matched to the refractive index of the first conducting layer.

[0015] A sixth aspect of the present invention is directed to a resistive touch panel including the features of the fifth aspect, wherein the refractive index of the liquid is matched to the refractive index of the second conducting layer.

[0016] A seventh aspect of the present invention is directed to a resistive touch panel including the features of the fifth aspect, wherein the refractive index of the liquid is higher than the refractive index of air.

[0017] An eighth aspect of the present invention is directed to a resistive touch panel including the features of the seventh aspect, wherein the refractive index of the liquid is chosen within an interval that provides reflection for incident light off the liquid in relation to the first electrically conducting layer that is below a selected percentage, which percentage may be 10 percent, with advantage around four percent and preferably less than one percent.

[0018] A ninth aspect of the present invention is directed to a resistive touch panel including the features of the first aspect, wherein the liquid is an oil-based liquid.

[0019] Other implementations of the present invention provide an information presenting device having an improved resistive touch panel.

[0020] According to a tenth aspect of the present invention, an information presenting device includes a resistive touch panel having a first flexible electrically conducting layer, a second electrically conducting layer, and a separating cham-